

Remarks/Arguments:

Claims 1-8 are pending and rejected in the application. Claims 1 and 5 have been amended. No new matter has been added.

On page 2, the Official Action rejects claims 1-4 under 35 U.S.C. §103(a) as being unpatentable over Kawamoto (JP 410109163) in view of Blankenship (U.S. 6,248,976) and further in view of Miyamoto (JP 2001-334365). On page 4, the Official Action rejects claims 5-8 under 35 U.S.C. §103(a) as being unpatentable over Kawamoto in view of Blankenship, in view of Miyamoto, in view of Churchward (U.S. 1,687,492) and further in view of Innami (U.S. 5,834,732). It is respectfully submitted, however, that the claims are patentable over the art of record for at least the reasons set forth below.

Applicants' invention, as recited by claim 1, includes features which are neither disclosed nor suggested by the art of record, namely:

... wherein at least one of:

a) the short-circuit waveform control circuit controls the welding voltage to decrease when the arc resistance exceeds a resistance threshold, controls the welding voltage to increase and the short-circuit period to decrease when the arc resistance is below the resistance threshold, and

b) the arc waveform control circuit controls the welding current to be held at a constant level when the arc resistance exceeds the resistance threshold, the constant level current being greater than a normal welding current generated based on the welding voltage.

Claim 1 relates to a short circuit waveform control circuit and an arc waveform control circuit which control the welding voltage and welding current respectively based on arc resistance. Support for these features can be at least found on pages 10-13 of Applicants' specification and furthermore shown in Figs. 1 and 3. No new matter has been added.

In Fig. 4, Kawamoto discloses current detector 8, voltage detector 1, short circuit arc judgment circuit 2, short circuit waveform control circuit 6, arc waveform control circuit 7 and switch 25. Thus, Kawamoto is able to control power element 5 with either short circuit waveform control circuit 6 or arc waveform control circuit 7 based on the judgment of short

circuit arc judgment circuit 2. Kawamoto, however, does not disclose or suggest controlling either circuits 6 or 7 based on arc resistance.

In similar art, Miyamoto, Blankenship, Innami and Churchward suggest determining arc resistance by dividing welding voltage with welding current and then controlling the welding current based on this resistance (see paragraph [0018] of Miyamoto). Thus, the Examiner is combining the teachings of Kawamoto with the teachings of Miyamoto, Blankenship, Innami and Churchward for suggesting controlling the short circuit and arc waveform control circuits 6 and 7 based on the arc resistance.

Neither Kawamoto, Miyamoto, Blankenship, Churchward or Innami, however, suggest the manner in which the welding current and/or welding voltage is controlled. Specifically, neither of the references nor their combination suggests controlling the welding voltage to decrease when the arc resistance exceeds a threshold and controlling the welding voltage to increase and short circuit period to decrease when the arc resistance is below the threshold. Furthermore, neither of the references suggests controlling the welding current to be held at a constant level when the arc resistance exceeds the threshold.

In paragraph [0006], Kawamoto suggests a constant current control period. In paragraphs [0009], [0012] and [0013], however, Kawamoto suggests that the constant current control is performed just after breaking a short circuit in the beginning of the arc period in order to prevent regeneration of a short circuit from occurring (*"since current control is carried out immediately after release of a short circuit, it is secured"*). Thus, Kawamoto teaches away from controlling the welding current to be held at a constant level when the arc resistance is above a threshold. Thus, it would not be obvious to combine the arc resistance teachings of Blankenship, Miyamoto, Churchward and Innami with the system of Kawamoto (it would not be obvious to control the welding voltage and welding current as recited in Applicants' claim 1 based on the arc resistance).

Applicants' claim 1 is different than the art of record, because at least one of a short circuit waveform control circuit controls the welding voltage and an arc waveform control circuit controls the welding current based on the arc resistance (*"... wherein at least one of: a) the short-circuit waveform control circuit controls the welding voltage to decrease when the arc resistance exceeds a resistance threshold, controls the welding voltage to increase and the short-circuit period to decrease when the arc resistance is below the resistance threshold, and*

b) the arc waveform control circuit controls the welding current to be held at a constant level when the arc resistance exceeds the resistance threshold, the constant level current being greater than a normal welding current generated based on the welding voltage ...").

Feature (a) of the wherein clause

Feature (a) is supported by at least Applicants' Fig. 1 where arc resistance calculator 1 outputs signal S6 to short circuit waveform control circuit 8. Specifically, if the arc resistance exceeds a resistance threshold, then short circuit waveform control circuit 8 decreases the welding voltage. If, however, the arc resistance is below a resistance threshold, short circuit waveform control circuit 8 increases the welding voltage while decreasing the short circuit period. A plot of the welding voltage, welding current and arc resistance for both a short circuit period and arc period is shown in at least Applicants' Fig. 2. Support for this feature is also found on page 10, lines 19-24 of Applicants' originally filed specification ("*when the arc resistance value becomes to high ... the welding voltage is lowered ... when the arc resistance value ... turn out to be to small ... the welding voltage is raised and the short circuit period is shortened*").

Feature (b) of the wherein clause

Feature (b) relates to an arc waveform control circuit controlling a welding current based on arc resistance. Support for feature (b) is at least found in Applicants' Fig. 3 where arc resistance calculator 1 outputs a signal S6 to arc waveform control circuit 9. Specifically, arc waveform control circuit 9 holds the welding current at a constant level when the arc resistance exceeds a threshold. The constant current level is greater than the normal welding current generated based on the welding voltage. This feature is also supported on page 13, lines 7-14 of Applicants' originally filed specification ("*based on the output, switching element 13 controls the welding power with a certain specific constant current value that is higher than that output at the normal constant voltage control in the arc period*").

Accordingly, for at least the reasons set forth above, claim 1 is patentable over the art of record.

Claims 2-4 include all of the features of claim 1 from which they depend. Thus, claims 2-4 are also patentable over the art of record for at least the reasons set forth above.

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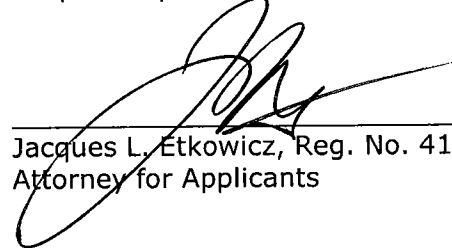
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Claim 5 includes similar features to claim 1. Thus, claim 5 is also patentable over the art of record for at least the reasons set forth above.

Claims 6-8 include all of the features of claim 5 from which they depend. Thus, claims 6-8 are also patentable over the art of record for at least the reasons set forth above.

In view of the foregoing remarks and amendments, Applicants respectfully submit that the above-identified application is in condition for allowance, which action is respectfully requested.

Respectfully submitted,



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